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# ELGAR CORPORATION

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Type 501
S/N 312
Rcvd 1-27-70
CH 17415 (Rev 4)

# INSTRUCTION MANUAL

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MP MASTER
MA29219

# SERIES 500
# POWER SOURCE

MODEL 501

SERIAL NO. 312

ELGAR
CORPORATION
8046 ENGINEER ROAD
SAN DIEGO, CALIFORNIA 92111
(714) 279-0800

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# TABLE OF CONTENTS


SECTION I — INTRODUCTION AND GENERAL DESCRIPTION

SCOPE OF MANUAL . . . . . 1-1
INTRODUCTION . . . . . 1-1
GENERAL DESCRIPTION . . . . . 1-1
SPECIFICATIONS . . . . . 1-2

SECTION II — PRELIMINARY INSPECTION, INSTALLATION, AND OPERATION

SECTION II
INSPECTION UPON RECEIPT . . . . . 2-1
INSTALLATION AND OPERATION . . . . . 2-1
28 VAC OPERATION . . . . . 2-1
230 VAC OPERATION . . . . . 2-1

SECTION III — THEORY OF OPERATION

CIRCUIT DESCRIPTION . . . . . 3-1
INTERCONNECTIONS FOR MULTIPHASE OPERATION . . . . . 3-1

SECTION IV — MAINTENANCE

SERVICE INFORMATION . . . . . 4-1
FACTORY REPAIR . . . . . 4-1
SHIPPING DAMAGE . . . . . 4-1
TEST POINTS . . . . . 4-1
OUTPUT REGULATION ADJUSTMENT . . . . . 4-1
TROUBLESHOOTING . . . . . 4-1
Circuit Breaker Trips . . . . . 4-1
Overheating . . . . . 4-1

SECTION V — PARTS LIST

CAPACITORS . . . . . 5-2
RESISTORS . . . . . 5-2
SEMICONDUCTORS . . . . . 5-2
TRANSISTORS . . . . . 5-3
TRANSFORMERS . . . . . 5-3
MISCELLANEOUS . . . . . 5-3


## LIST OF ILLUSTRATIONS


FIGURE

1-1 POWER OUTPUT DERATING VS OUTPUT VOLTAGE . . . . . 1-1
2-1 REAR PANEL TERMINAL STRIP CONNECTIONS . . . . . 2-2
3-1 SCHEMATIC DIAGRAM . . . . . 3-3
3-2 INTERCONNECTIONS FOR MULTIPHASE OPERATION . . . . . 3-5
4-1 TOP AND REAR VIEW . . . . . 4-2


## LIST OF TABLES


TABLE

1-1 SPECIFICATIONS . . . . . 1-2

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# SECTION I

# INTRODUCTION AND GENERAL DESCRIPTION

## SCOPE OF MANUAL

This manual describes the Series 500 Power Source manufactured by Elgar Corporation. It contains operating and maintenance instructions, circuit descriptions, a circuit diagram, and a parts list.

## INTRODUCTION

The Series 500 Power Sources provide AC power at precise frequencies for testing, motor operation, and frequency conversion. The basic power amplifier consists of two DC supplies and a 4-stage, transformer-coupled amplifier with an adjustable power output transformer. The output transformer provides nominal output voltages of 28, 115, and 230 VAC. Total available power is 500 volt-amperes at full-rated outputs of 28, 115, or 230 VAC. Power at less than full voltages is derated as illustrated in Figure 1-1. Input power is 115 or 230 VAC at 50 or 60 Hz. Units operating with 400 Hz input power are available on special order.

Output power frequency is established by a plug-in oscillator. Output frequency range is 45 to 10,000 Hz. The output is derated to half power at frequencies above 5 KHz. A variety of plug-in oscillators are available, with frequency accuracy up to 0.0001%.

The Elgar Power Source facilitates equipment tests to meet military-specification operating requirements over the frequency range of 47 to 63 Hz or 47 to 425 Hz. The basic power amplifier output is single phase, but multiphase power output can be obtained by stacking two or three power amplifiers, all driven by the same plug-in oscillator.

## GENERAL DESCRIPTION

The Series 500 Power Source is contained in a rack-mount enclosure with a meter for power output monitoring,

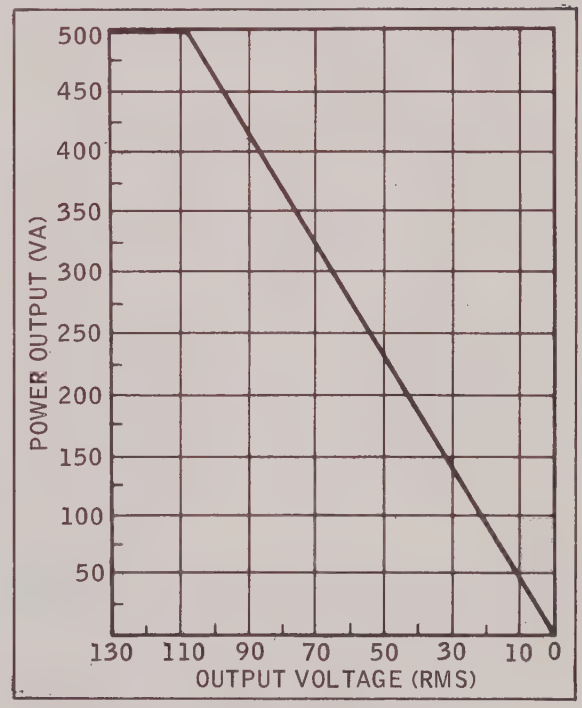



FIGURE 1-1. POWER OUTPUT DERATING VS OUTPUT VOLTAGE

a POWER ON indicator lamp, an output voltage AMPLITUDE control and a POWER switch-circuit breaker located on the front panel. Cooling air is drawn through a front panel grill and exhausted at the rear of the enclosure.

The enclosure contains two heatsinks which comprise a power amplifier. Control circuitry is mounted on a circuit board with test points and adjustment controls available at the top of the board. Output power is available at a rear panel terminal strip and at front panel connectors. An input power cord is located on the rear panel.

## SPECIFICATIONS

Specifications for the Series 500 are provided in Table 1-1.

| | |
|---|---|
| OUTPUT POWER | 0-500 VA |
| POWER FACTOR | Unity to ±0.7 |
| OUTPUT VOLTAGE | Adjustable 0-28 VAC, 0-130 VAC, or 0-260 VAC |
| OUTPUT FREQUENCY RANGE | 45 Hz to 5000 Hz at full power output |
| DISTORTION | Less than 1% - 45 Hz to 5000 Hz |
| LOAD REGULATION | 1% - 45 Hz to 5000 Hz |
| LINE REGULATION | 1/2% - 115 VAC ± 10 VAC<br>1/2% - 230 VAC ± 20 VAC |
| SHORT CIRCUIT PROTECTION | Output may be shorted indefinitely and recovers immediately when short is removed |
| INPUT POWER | 115 VAC ± 10 VAC, or<br>230 VAC ± 20 VAC, 45 Hz to 480 Hz<br>1500 Watts maximum |
| TEMPERATURE RANGE | 0 - 50°C |
| DIMENSIONS | 7 in. x 19 in. relay rack panel by 17-1/2 in. deep overall |
| WEIGHT | Approximately 100 lbs. |

TABLE 1-1. SPECIFICATIONS

# SECTION II

# PRELIMINARY INSPECTION AND OPERATION

## INSPECTION UPON RECEIPT

The Elgar Power Source has been aligned, calibrated, and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made, however, to assure that the instrument has suffered no damage during shipment.

1. Make a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damages should be noted on the carrier's receipt, and signed by the driver of carrier agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier and all shipping containers and filler material saved for inspection. Forward a report of damage to the Elgar Service Department, which will provide instructions for repair or replacement of the instrument.

2. Make a visual inspection of the instrument when it is removed from the shipping container.

## INSTALLATION AND OPERATION

Operating the Elgar Power Source requires only the following steps:

1. Install the power source so that the flow of cooling air into the front panel grill and out the rear panel grill is unobstructed.

2. Insert the plug-in oscillator.

3. Connect the power output load to rear panel terminal board.

4. Plug power cord on rear panel to source of AC line power.

5. Set the front panel POWER switch to ON. The indicator on the front panel illuminates when power is applied.

6. Adjust the front panel AMPLITUDE control for the desired output voltage.

NOTE

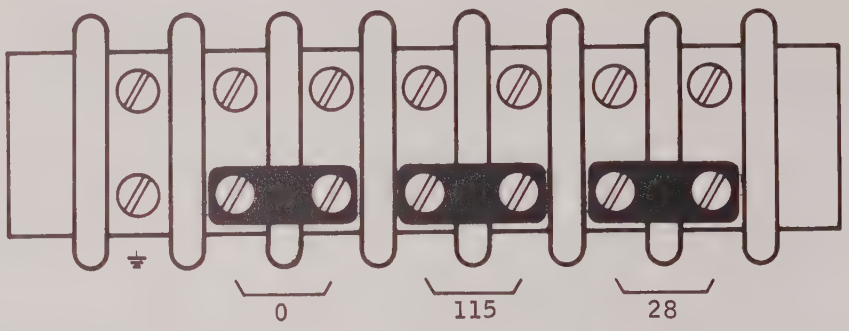
Certain Elgar plug-in oscillators do not require the use of the AMPLITUDE control; others are externally programmed. Consult the oscillator instruction manual.

## 28 VAC OPERATION

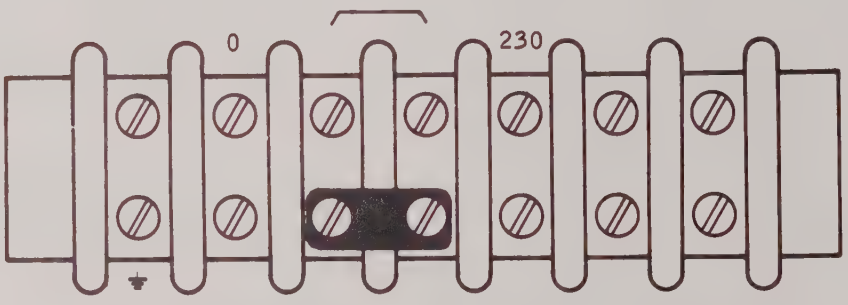
Because of the amplifier current limiting circuitry, full power cannot be obtained from the 115 volt output operating at 28 volts (nominal). A 28-volt tap is provided on the output transformer to permit full power (18 amperes) to be taken from the power source at outputs of 28 volts or less. The front panel meter is wired to one of the 115 volt windings of the output transformer. When operating at 28 volts, full output voltage is indicated by a reading of approximately 115 volts. Rear panel terminal board jumper connections for 28 and 115 volt operation are illustrated in Figure 2-1.

## 230 VAC OPERATION

For 230 VAC operation, the jumpers on the rear panel output terminal board are changed to connect the two secondary windings of the output transformer in series. The jumper connections for 230 VAC operation are illustrated in Figure 2-1.




PARALLEL JUMPER CONNECTIONS FOR 0, 28, and 115 VAC OPERATION




SERIES JUMPER CONNECTIONS FOR 230 VAC OPERATION

FIGURE 2-1. REAR PANEL TERMINAL BOARD CONNECTIONS

# SECTION III

# THEORY OF OPERATION

## CIRCUIT DESCRIPTION

The input signal, at approximately 3 VRMS, is provided by the plug-in oscillator. The signal is applied to the preamplifier comprised of transistors Q1, Q2, and Q3 (see Figure 3-1). (Transistors Q1 and Q2 are located on the circuit board, and Q3 is on heatsink No. 3.) Transistor Q3 is transformer-coupled through transformer T4 to the Class B power amplifier which is comprised of two identical heatsinks (designated No. 1 and No. 2). CR5 in the preamplifier circuit is a 2N3638 transistor used as a Zener diode.

The power amplifier consists of transistors Q5 through Q11, and Q12 through Q18. The amplifier circuit has a small forward bias across diodes CR6 and CR7 from currents developed by resistors R22 and R24 in heatsink No. 1 and R32 and R34 in heatsink No. 2. Thermostat S1, which is mounted on heatsink No. 1, provides thermal protection for the instrument if it overheats due to an obstruction over the ventilating grill, or if the instrument is operated in an environment of too-high ambient temperature. If the unit reaches an unsafe operating temperature, S1 closes, grounding the collector of Q4 which causes the lamp in photocell CLM4012 to illuminate. This attenuates the input signal, reducing the output current to a low level until the operating temperature returns to normal.

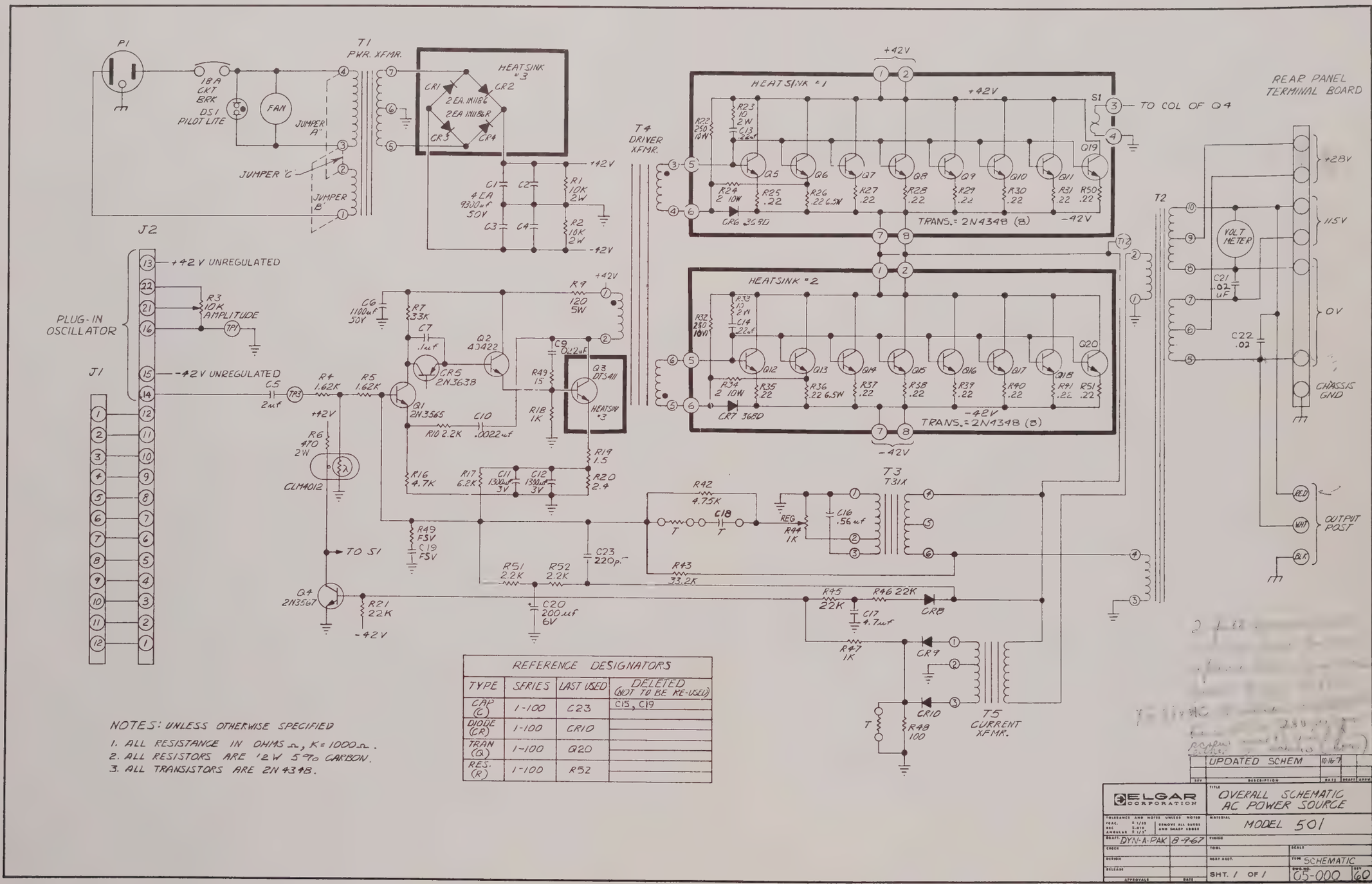
Distortion in the power amplifier section is reduced by a negative voltage feedback developed through resistor R43. A positive current feedback signal is developed in the resistance in the primary winding of transformer T2. This signal, which improves output-load regulation, is sensed by current feedback transformer T3, and is coupled through potentiometer R44 to provide regulation adjustment. The power amplifier is protected by the current-limiting circuit which utilizes current limiting transformer T5 to sense the current in output transformer T2. This is accomplished by passing the lead from T2 through the coil of T5 to form a one-turn primary loop. The current sensing signal is rectified in diodes CR9 and CR10, and compared to the -42V at transistor Q4. Overload currents turn on Q4 which, in turn illuminates the lamp in photocell CLM4012. The photocell is connected to input resistors R4 and R5, and when the lamp illuminates, the input signal is attenuated.

The amplifier output signal at TP2 is rectified by diode CR8 and introduced into the current limiting circuit through resistors R45 and R46. This provides additional protection to the output transistors by reducing the output current during short circuit conditions.

The output signal amplitude potentiometer R3 is connected through the plug-in oscillator circuit, and its use is dependent upon the type of plug-in unit used (refer to plug-in oscillator instruction manual). Power transformer (T1) output is rectified in diode bridge CR1-CR4.

## INTERCONNECTIONS FOR MULTIPHASE OPERATION

Two phase operation requires two power amplifiers. Three phase operation can be accomplished with three amplifiers in "Wye" connection, or with two amplifiers in either "Wye" or open Delta connection. For two-amplifier "Wye" connection, the two secondaries on the slave amplifier gives the phase "C" output. The remaining windings from the two amplifiers are connected in series to give the phase "B" output which is the negative vector sum of the phase "A" and "C" outputs (see Figure 3-2).




REFERENCE DESIGNATORS

| TYPE | SERIES | LAST USED | DELETED (NOT TO BE RE-USED) |
|---|---|---|---|
| CAP (C) | 1-100 | C23 | C15, C19 |
| DIODE (CR) | 1-100 | CR10 | |
| TRAN (Q) | 1-100 | Q20 | |
| RES. (R) | 1-100 | R52 | |

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE IN OHMS Ω, K=1000Ω.
2. ALL RESISTORS ARE 1/2W 5% CARBON.
3. ALL TRANSISTORS ARE 2N4348.

| | | |
|---|---|---|
| UPDATED SCHEM | 10-16-7 | |
| DESCRIPTION | DATE | DRAFT APPR |

ELGAR CORPORATION

TITLE: OVERALL SCHEMATIC AC POWER SOURCE

MODEL 501

DRAFT: DYN-A-PAK 8-9-67

TYPE: SCHEMATIC

SHT. 1 OF 1

DWG NO. 05-000 REV 60

FIGURE 3-1. SCHEMATIC DIAGRAM

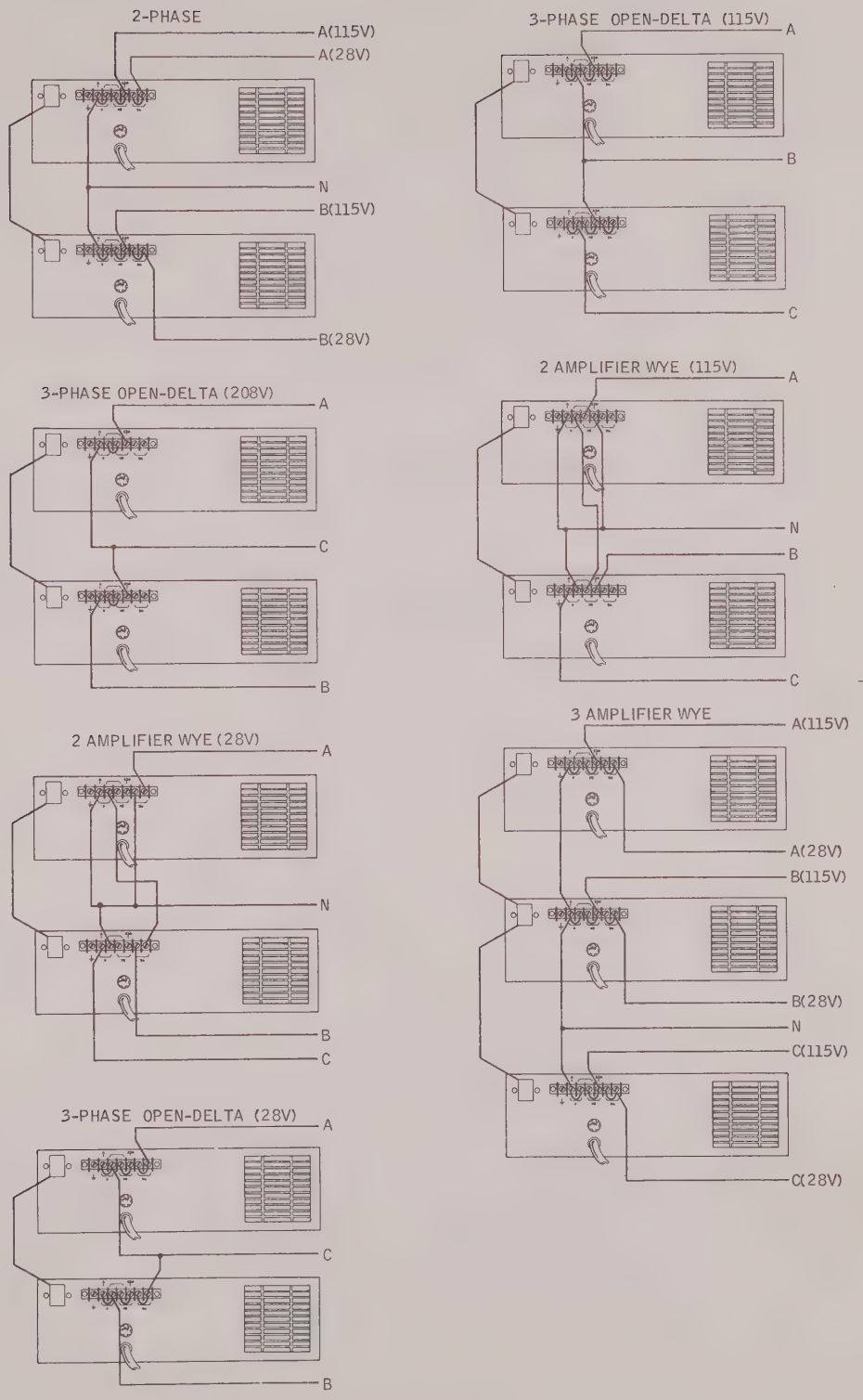



FIGURE 3-2. INTERCONNECTIONS FOR MULTIPHASE OPERATION

# SECTION IV

# MAINTENANCE

## SERVICE INFORMATION

Questions concemed with the operation, repair, or servicing of this instrument should be directed to the nearest Elgar representative or to the company's Service Department. INCLUDE THE MODEL NUMBER AND SERIAL NUMBER in any correspondence concerning this instrument.

## FACTORY REPAIR

Should it be necessary to return an instrument to the factory for repair, please contact the Elgar Corporation Service Department for authorization to make shipment.

DO NOT RETURN THE UNIT FOR REPAIR WITHOUT AUTHORIZATION.

## SHIPPING DAMAGE

It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, notify the carrier immediately. The carrier's claim agent will prepare a report of damage to be forwarded to the Elgar Service Department. You will be advised as to the action necessary to have the instrument repaired or replaced.

## TEST POINTS

Test points are located on the circuit board, and adjustment controls are conveniently provided at the top of the control circuit board (see Figure 4-1). Adjustment procedures are given in the following paragraph.

## OUTPUT REGULATION ADJUSTMENT

The output should remain within the specified ±1% after it has been adjusted for frequency and load conditions. It is adjusted as follows:

a. With the load disconnected from the power source, read the output voltage. Use a differential voltmeter (Fluke or equivalent) to obtain precise reading. The output voltage can be read at rear panel terminal board.

b. Connect the power source to the normal operating load.

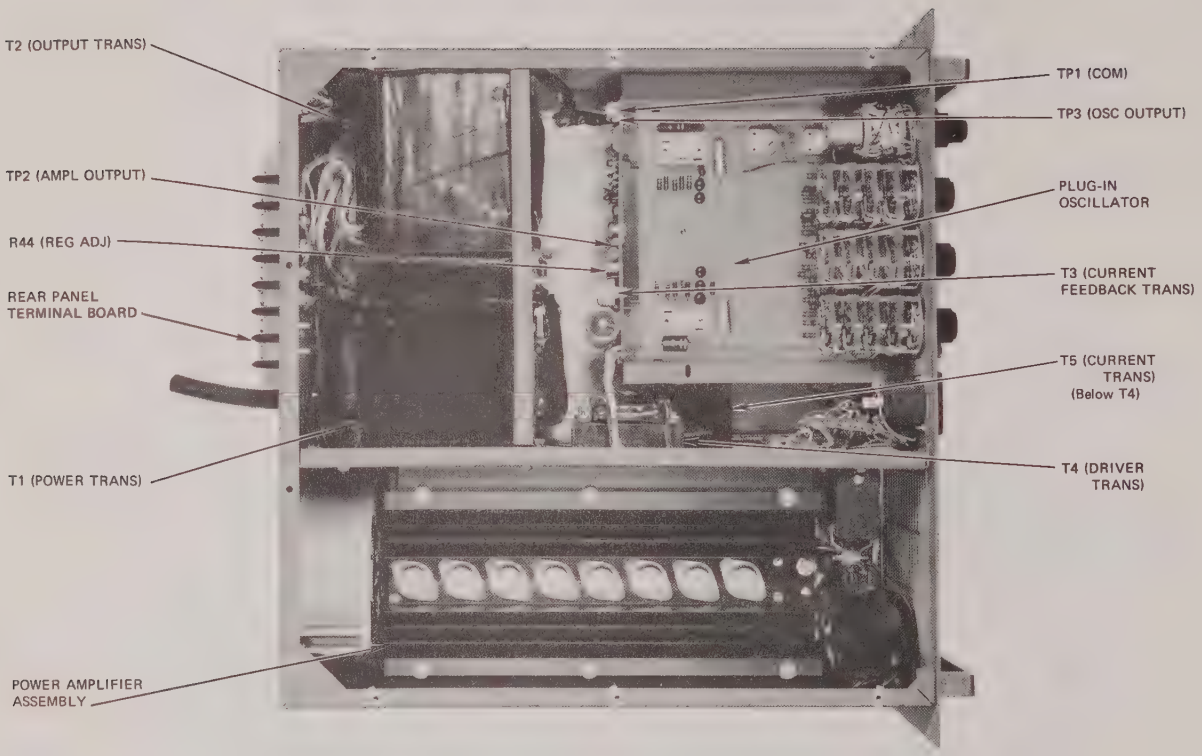
c. Measure the output voltage and, using the circuit board adjustment potentiometer (R44), adjust the output voltage until it is the same as that obtained under no load conditions.

d. Repeat steps (a) through (c) for accuracy.

## TROUBLESHOOTING

CIRCUIT BREAKER TRIPS. Tripping of the circuit breaker can indicate failure of a power amplifier transistor or a power rectifier. To check, pull out both heatsink connector plugs, and reapply power to the instrument. If the breaker trips again, the trouble is in the power rectifier. If the breaker does not trip, check transistors on the power amplifier heatsink circuits.

OVERHEATING. If the instrument overheats due to obstructed airflow through the ventilating grill or excessive ambient temperature, a thermostat on the heatsink causes the output current to be reduced to a low level until temperature returns to normal.



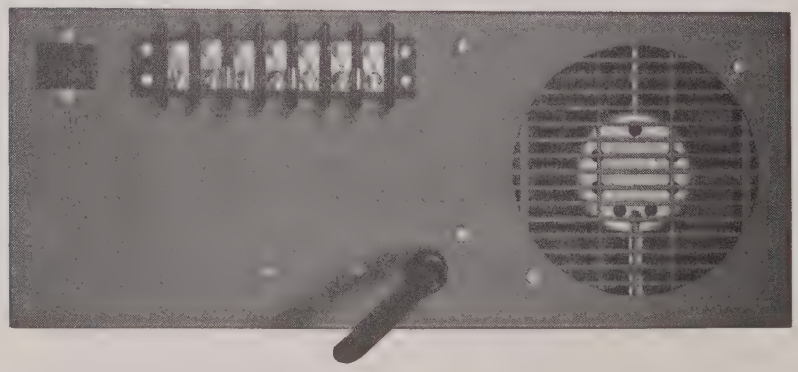



FIGURE 4-1. TOP AND REAR VIEW

# SECTION V

# PARTS LIST

| SCHEMATIC DESIGNATION | VALUE | DESCRIPTION OR TYPE | RATING | MANUFACTURER NAME | MANUFACTURER PART NO. |
|---|---|---|---|---|---|
| **CAPACITORS** | | | | | |
| C1, C2, C3, C4 | 9300 uf | ELECT | 50V | G.E. | 86F168M |
| C5 | 2 uf | MYLAR | 200V | ELPAC | ZD2A205J |
| C6 | 1100 uf | ELECT | 50V | SPRAGUE | 39D118G050 |
| C7 | 0.1 uf | MYLAR | 200V | ELPAC | ZD2A104J |
| C9 | 0.022 uf | MYLAR | 200V | SPRAGUE | 192P |
| C10 | 0.0022 uf | CER DISC | | ERIE | 811Z5V222P |
| C11, C12 | 1300 uf | ELECT | 3V | SPRAGUE | 39D138G003 |
| C13, C14 | 0.22 uf | MYLAR | 200V | ELPAC | ZD2A224J |
| C16 | 0.56 uf | MYLAR | 200V | ELPAC | ZD2A504J |
| C17 | 4.7 uf | TANT | 35V | SPRAGUE | CS13BF475K |
| C18 | Factory Select | | | | |
| **RESISTORS** | | | | | |
| R1, R2 | 10K | CARB COMP | 2W 5% | OHMITE | |
| R3 | 10K | POTENTIOMETER | | HELIPOT | 7246R10K |
| R4, R5 | 1.62K | MET FILM | 1/8W 1% | TEXAS INST | RN60C1621F |
| R6 | 470 | CARB COMP | 2W 5% | OHMITE | |
| R7 | 33K | CARB COMP | 1/2W 5% | OHMITE | |
| R9 | 120 | WW | 5W 5% | DALE | CW5 |
| R10 | 4.7K | CARB COMP | 1/2W 5% | OHMITE | |
| R17 | 6.2K | CARB COMP | 1/2W 5% | OHMITE | |
| R18, R47 | 1000Ω | CARB COMP | 1/2W 5% | OHMITE | |
| R19 | 1.5Ω | WW | 50W 5% | DALE | RH50 |
| R20 | 2.4Ω | WW | 10W 5% | DALE | RS10 |
| R21, R45, R46 | 22K | CARB COMP | 1/2W 5% | OHMITE | |
| R22, R32 | 250Ω | WW | 10W 5% | DALE | CW10 |
| R23, R33 | 10Ω | CARB COMP | 2W 5% | OHMITE | |
| R24, R34 | 2Ω | WW | 10W 5% | DALE | CW10 |
| R25-R31, R35-R41, R50, R51 | 0.22Ω | WW | 5W 5% | DALE | CW5 |
| R42 | 4.75K | MET FILM | 1/8W 1% | TEXAS INST | RN60C4751F |
| R43 | 33.2K | MET FILM | 1/8W 1% | TEXAS INST | RN60C3322F |
| R44 | 1000Ω | TRIMPOT | | HELIPOT | 78PR1K |
| R48 | 100Ω | CARB COMP | 2W 5% | OHMITE | |
| R49 | 47 | CARB COMP | 1/2W 5% | OHMITE | |
| **SEMICONDUCTORS** | | | | | |
| CR1, CR3 | | RECTIFIER | | WESTINGHOUSE | 1N1186R |
| CR2, CR4 | | RECTIFIER | | WESTINGHOUSE | 1N1186 |
| CR5 | | TRANSISTOR | | FAIRCHILD | 2N3638 |
| CR6, CR7 | | RECTIFIER | | WESTINGHOUSE | 409D |
| CR8, CR9, CR10 | | DIODE | | CONTINENTAL | 1N457 |

| SCHEMATIC DESIGNATION | VALUE | DESCRIPTION OR TYPE | RATING | MANUFACTURER | |
|---|---|---|---|---|---|
| | | | | NAME | PART NO. |
| TRANSISTORS | | | | | |
| Q1 | | | | FAIRCHILD | 2N3565 |
| Q2 | | | | MOTOROLA | 2N3767 |
| Q3 | | | | DELCO | DTS411 |
| Q4 | | | | FAIRCHILD | 2N3567 |
| Q5-Q20 | | | | RCA | 2N4348 |
| TRANSFORMERS | | | | | |
| T1 | | PWR TRANSFORMER | | ELGAR | 90-047-90 |
| T2 | | OUTPUT TRANS-FORMER | | ELGAR | 90-046-90 |
| T3 | | SENSING | | TRIAD | T31X |
| T4 | | DRIVER | | ELGAR | 90-056-90 |
| T5 | | CURRENT | | ELGAR | 90-049-90 |
| MISCELLANEOUS | | | | | |
| CLM4012 | | PHOTOMODU-LATOR | | CLAIREX | CLM4012 |
| S1 | | THERMOSTAT | | STEMCO | A505 |
| S2 | | CIRCUIT BREAKER | | HEINEMAN | JA1-A3-13-18-3 |
| B1 | | FAN | | PAMOTOR | 7500 |
| M1 | | VOLTMETER | | AMMON | AM-1 |
| POWER AMPLIFIER | | HEATSINK WITH THERMOSTAT | | ELGAR | 07-210-40 |
| POWER AMPLIFIER | | HEATSINK WITHOUT THERMOSTAT | | ELGAR | 07-213-40 |
| OSCILLATOR | 400 Hz | PLUG-IN | | ELGAR | 441-0 1 |

# WARRANTY

Elgar Corporation warrants each instrument it manufactures to be free from defects in material and workmanship. The corporation's obligation under this warranty is limited to servicing the instrument and replacing defective parts, when the instrument is returned to the factory and transportation charges pre-paid. This warranty is effective for one year after delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, misuse, negligence, or the alteration or removal of the nameplate, will void the warranty. Elgar Corporation shall in no circumstance be liable for any direct or consequential loss or damage of any nature resulting from the malfunction of the instrument. This warranty is effective in lieu of any or all other obligations or liabilities on the part of Elgar Corporation, its agents, or representatives.

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